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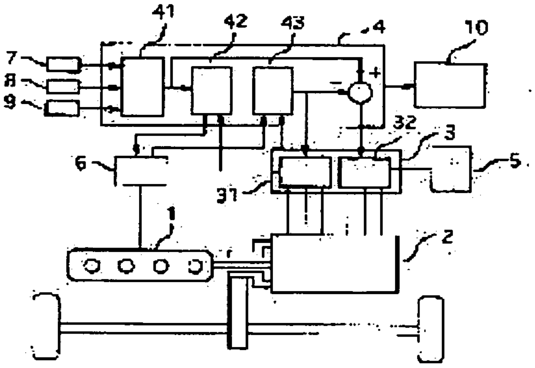
(54) ROTARY ELECTRIC MACHINE FOR HYBRID VEHICLE

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a rotary electric machine of a relative rotation double rotor type for a hybrid vehicle which can prevent demagnetization of a magnet to be caused by temperature rise, while restraining output decrease with simple constitution.

SOLUTION: A first rotary electric machine constituted of a relative rotation double rotor type magnet system synchronous machine is installed between an engine 1 and an axle, which has a well-known power converting part 2 to be driven by a second rotary electric machine. The power converting part 2 performs the well-known hybrid vehicle control wherein an engine output command value and an engine rotational frequency command value are determined on the basis of a vehicle torque command value and a vehicle running speed, a torque command value of the first rotary electric machine is so determined that deviation between the engine rotational frequency command value and an engine rotational frequency detected value converges to zero, and a torque command value of the second rotary electric machine is determined on the basis of the difference between the vehicle torque command value and the torque command value of the first rotary electric machine. The temperature of a permanent magnet of the power converting part 2 is estimated on the basis of these data.



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CLAIMS

[Claim(s)]
[Claim 1] the 1st rotator connected with an engine, and said 1st rotator -- relativity -- with the 1st dynamo-electric machine which carries out power transfer with accumulation-of-electricity equipment through an inverter while consisting of a relative rotation duplex Rota mold magneto system synchronous machine which has the 2nd rotator which carries out an electromagnetic coupling pivotable and drives a wheel The power transducer which has the 2nd dynamo-electric machine which carries out power transfer with said accumulation-of-electricity equipment through an inverter, and drives said wheel, It has the control unit which controls said engine and said power transducer. And said control unit The car torque command value decision section which determines the car torque command value which outputs a torque command value based on the actuation information inputted, The engine power command value decision section which determines an engine power command value based on said car torque command value and a car travel speed at least, The engine-speed command value decision section which determines an engine-speed command value based on said engine power command value, It is determined that the torque command value of the 1st dynamo-electric machine will complete it as 0 based on the deflection of said engine-speed command value and an engine-speed detection value. Furthermore, the dynamo-electric machine torque command value decision section which determines the torque command value of said 2nd dynamo-electric machine including the difference between said car torque command values and torque command values of said 1st dynamo-electric machine, In the dynamo-electric machine equipment for hybrid cars which controls said engine and both dynamo-electric machines according to a preparation and each aforementioned command value said control section The data read into said control section for control of said engine and said both dynamo-electric machines, And dynamo-electric machine equipment for hybrid cars characterized by presuming the magnet temperature of the permanent magnet of said 1st dynamo-electric machine based on the data for which it asked based on said data for control of said engine and said both dynamo-electric machines.
[Claim 2] the 1st rotator connected with an engine, and said 1st rotator -- relativity -- with the 1st dynamo-electric machine which carries out power transfer with accumulation-of-electricity equipment through an inverter while consisting of a relative rotation duplex Rota mold magneto system synchronous machine which has the 2nd rotator which carries out an electromagnetic coupling pivotable and drives a wheel A power conversion means to have the 2nd dynamo-electric machine which carries out power transfer with said accumulation-of-electricity equipment through an inverter, and drives said wheel, It has the control unit which controls said engine and said power conversion means. And said control unit The car torque command value decision section which determines a car torque command value based on the actuation information inputted, and the engine power command value decision section which determines an engine power command value based on said car torque command value and a car travel speed at least, The engine-speed command value decision section which determines an engine-speed command value based on said engine power command value, It is determined that the torque command value of the 1st dynamo-electric machine will complete it as 0 based on the deflection of said engine-speed command value and an engine-speed detection value. Furthermore, the dynamo-electric machine torque command value decision section which determines the torque command value of said 2nd dynamo-electric machine including the difference between said car torque command values and torque command values of said 1st dynamo-electric machine, In the dynamo-electric machine equipment for hybrid cars which controls said engine and both dynamo-electric machines according to a preparation and each aforementioned command value said control section The data read into said control section for control of said engine and said both dynamo-electric machines, And it is based on the data for which it asked based on said data for control of said engine and said both

dynamo-electric machines. Dynamo-electric machine equipment for hybrid cars characterized by determining the maximum of the armature current in the range which does not produce irreversible demagnetization of the permanent magnet of said 1st dynamo-electric machine, and restricting said armature current to said under maximum.

[Claim 3] It is dynamo-electric machine equipment for hybrid cars characterized by memorizing beforehand the relation between the output torque value of said 1st dynamo-electric machine calculated from said engine power command value which said control section calculated in the dynamo-electric machine equipment for hybrid cars according to claim 1 or 2, and said engine-speed detection value, the torque command value of said 1st dynamo-electric machine, and the maximum of magnet temperature or the armature current, and determining the maximum of said magnet temperature or the armature current based on said relation.

[Claim 4] It is dynamo-electric machine equipment for hybrid cars characterized by to calculate the inertia torque of the rotation system in which said control section contains said engine and 1st rotator in the dynamo-electric machine equipment for hybrid cars according to claim 3, to memorize beforehand relation with the maximum of said inertia torque, said output torque value and the torque command value of said 1st dynamo-electric machine, said magnet temperature, or the armature current, and to determine the maximum of said magnet temperature or the armature current based on said relation.

[Claim 5] It is dynamo-electric machine equipment for hybrid cars characterized by for said control section memorizing beforehand the relation between the sum total of said inertia torque and said output torque value or the ratio of said output torque value and torque command value of said 1st dynamo-electric machine, and the charge-and-discharge power of said accumulation-of-electricity equipment in the dynamo-electric machine equipment for hybrid cars according to claim 3 or 4, and judging the degree of degradation of the permanent magnet of said 1st dynamo-electric machine based on said relation.

[Claim 6] It is dynamo-electric machine equipment for hybrid cars characterized by said control section amending relation with the maximum of relation with the maximum of said inertia torque, said output torque value and the torque command value of said 1st dynamo-electric machine, said magnet temperature, or the armature current or said output torque value and the torque command value of said 1st dynamo-electric machine, said magnet temperature, or the armature current based on said judgment result in the dynamo-electric machine equipment for hybrid cars according to claim 5.

[Claim 7] It is dynamo-electric machine equipment for hybrid cars characterized by presuming the temperature of the armature coil of said 1st dynamo-electric machine based on the armature current value into which said control section is inputted as said permanent magnet temperature in the dynamo-electric machine equipment for hybrid cars according to claim 1.

[Claim 8] Based on the temperature of the armature coil of said 1st dynamo-electric machine which said control section presumed in the dynamo-electric machine equipment for hybrid cars according to claim 7, it is dynamo-electric machine equipment for hybrid cars characterized by determining the maximum of the armature current in the range which does not produce insulating coat degradation of said armature coil, and restricting said armature current to said under maximum.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[Field of the Invention] This invention relates to the relative rotation duplex Rota mold dynamo-electric machine equipment for hybrid cars.
[Description of the Prior Art] The method which uses a relative rotation duplex Rota mold dynamo-electric machine (only henceforth a duplex Rota motor) for the transmission of the hybrid car which changes a part of engine power or all power into power, and is changed into wheel power driven is learned. This dynamo-electric machine has Rota of a pair rotated mutually-independent, meeting possible [an electromagnetic coupling]. It is suitable to use association of the magneto system synchronous machine mold which uses one side as the permanent-magnet type field pole, and uses another side as an armature coil as an electromagnetic coupling between both Rota. The power proportional to the angular relation speed difference of both Rota arises in an armature coil, the power proportional to the angular velocity of the lower one is transmitted to Rota by the side of a low speed from Rota by the side of a high speed, through other dynamo-electric machines, it is changed into wheel power or the above-mentioned power is transmitted to accumulation-of-electricity equipment or an auxiliary machinery motor. In this magneto system synchronous machine type of relative rotation duplex Rota mold dynamo-electric machine (only henceforth a duplex Rota motor) In elevated-temperature heavy load operation, magnetic demagnetization (irreversible) poses [the permanent magnet of Rota] a problem. For this reason, conventionally Restrict the armature current to the range which such demagnetization does not produce beforehand at slight lowness, or Or the measures of restricting the armature current or strengthening cooling based on the detection temperature of the temperature sensor built in in the magnet rotation mold dynamo-electric machine, so that the internal temperature of a magnet rotation mold dynamo-electric machine may not exceed a permissible maximum temperature are taken.
[Problem(s) to be Solved by the Invention] However, since the magnet rotation mold dynamo-electric machine physique is increased in vain, it is not desirable to always restrict the armature current so that magnetic demagnetization may not arise in the highest operating temperature, either. Carrying out the operation control of the magnet rotation mold dynamo-electric machine in the range which builds in a temperature sensor in a magnet rotation mold dynamo-electric machine, changes the control mode of a magnet rotation mold dynamo-electric machine in the possible range according to detection temperature, corresponding to it in taking the measures like **** ****, and magnetic demagnetization does not produce can aim at an output rise without physique increase, and it is convenient. However, since dispersion in each part temperature in a magnet rotation mold dynamo-electric machine is large, unless a temperature sensor approaches a permanent magnet as much as possible and it forms it, the temperature gradient between magnet temperature and detection temperature will become large, and the delay of the response of change (rise) of detection temperature to change (rise) of magnet temperature will arise, and it will need to expect and carry out safety design of this, and cannot expect sufficient improvement in an output. Naturally, although it is a location close to a permanent magnet, with a magnet rotation mold dynamo-electric machine, the support of a temperature sensor which similarly carries out high-speed rotation in order that a permanent magnet may carry out high-speed rotation is not easy for the most suitable arrangement location of a temperature sensor, and in order to take out a signal from a temperature sensor further, it needs to add the pair of the slip ring and a brush, and poses a problem on utilization of complication of a configuration. It sets it as the purpose to offer the relative rotation duplex Rota mold dynamo-electric machine equipment for hybrid cars which can prevent demagnetization of the magnet by the temperature rise, this invention being made in view of the above-mentioned trouble, and inhibiting loss of power with a simple configuration.
[Means for Solving the Problem] The 1st dynamo-electric machine with which the dynamo-electric machine

equipment for hybrid cars according to claim 1 consists of a relative rotation duplex Rota mold magneto system synchronous machine between an engine and an axis arm is formed, and an axis arm has further the well-known power transducer driven with the 2nd dynamo-electric machine. This power transducer determines an engine power command value and an engine-speed command value based on a car torque command value and a car travel speed. It is determined that the torque command value of the 1st dynamo-electric machine will complete it as 0 based on the deflection of this engine-speed command value and an engine-speed detection value. Well-known hybrid car control which determines the torque command value of the 2nd dynamo-electric machine based on the difference between a car torque command value and the torque command value of the 1st dynamo-electric machine is performed. In this invention, the magnet temperature of the permanent magnet of the 1st dynamo-electric machine is presumed based on the data especially used in process of the ****. If it does in this way, the relative rotation duplex Rota mold dynamo-electric machine equipment for hybrid cars which can prevent demagnetization of the magnet by the temperature rise is realizable, inhibiting loss of power with a simple configuration. Furthermore, if it explains concretely, in this invention, the magnet temperature of the 1st dynamo-electric machine will be presumed based on the data calculated inside based on the data or it which was detected in order to use for hybrid car control. For this reason, even if a dynamo-electric machine like the duplex Rota motor of a hybrid car with which operational status is changed frequently sets, magnet temperature is detectable without a time lag on real time. Consequently, if the detected magnet temperature serves as an elevated temperature, it can warn of it, or the armature current can be restricted and it can cope with preventing magnet demagnetization etc. to suitable timing. Moreover, it is not necessary to form an additional sensor, and since there are also few increases of a burden of signal-processing actuation, the burden of configuration complication of hardware or software is also small. Furthermore, since it is not necessary to restrict the armature current too much or to adopt the temperature rise suppression measure of enlarging the physique of a dynamo-electric machine for fear of the magnet demagnetization at the time of the elevated-temperature large armature current, the weight of the dynamo-electric machine per capability and a loading tooth space can be reduced. The 1st dynamo-electric machine with which the dynamo-electric machine equipment for hybrid cars according to claim 2 consists of a relative rotation duplex Rota mold magneto system synchronous machine between an engine and an axis arm is formed, and an axis arm has further the well-known power transducer driven with the 2nd dynamo-electric machine. This power transducer determines an engine power command value and an engine-speed command value based on a car torque command value and a car travel speed. It is determined that the torque command value of the 1st dynamo-electric machine will complete it as 0 based on the deflection of this engine-speed command value and an engine-speed detection value. Well-known hybrid car control which determines the torque command value of the 2nd dynamo-electric machine based on the difference between a car torque command value and the torque command value of the 1st dynamo-electric machine is performed. In this invention, based on the data especially used in process of the ****, the permission maximum of the armature current of the 1st dynamo-electric machine is determined, and the 1st dynamo-electric machine is operated in not more than it. If it does in this way, the relative rotation duplex Rota mold dynamo-electric machine equipment for hybrid cars which can prevent demagnetization of the magnet by the temperature rise is realizable, inhibiting loss of power with a simple configuration. Furthermore, if it explains concretely, in this invention, the permission maximum of the armature current will be determined based on the data calculated inside based on the data or it which was detected in order to use for hybrid car control, and the 1st dynamo-electric machine will be operated in not more than it. For this reason, even if a dynamo-electric machine like the duplex Rota motor of a hybrid car with which operational status is changed frequently sets, magnet temperature is detectable without a time lag on real time. Consequently, the output per the weight and loading tooth space can be improved, without a permanent magnet's being able to operate a dynamo-electric machine in the last-minute range which does not carry out irreversible demagnetization, and increasing the physique in vain. Moreover, it is not necessary to form an additional sensor, and since there are also few increases of a burden of signal-processing actuation, the burden of configuration complication of hardware or software is also small. Furthermore, the magnet demagnetization at the time of the elevated-temperature large armature current is feared. According to the configuration according to claim 3, since the maximum of magnet temperature or the armature current is further determined for relation with the maximum of the output torque value of the 1st dynamo-electric machine and a torque command value, magnet temperature, or the armature current based on storage in the dynamo-electric machine equipment for hybrid cars according to claim 1 or 2 beforehand, the maximum of magnet temperature or the armature current can be determined often [precision] and without delay. According to the configuration according to claim 4, since the maximum of magnet temperature or the armature current is determined based on relation with the maximum of the inertia torque of the rotation system which contains an engine and the 1st rotator further, the output torque value of the 1st dynamo-electric machine and a torque command value, magnet temperature, or the armature current in the dynamo-electric machine equipment for hybrid cars according to claim 3, the error under the effect of inertia torque is cancelable. Since the degree of degradation (irreversible demagnetization) of the permanent magnet of the 1st dynamo-electric machine is further judged based on the relation between the sum total of inertia torque and output torque value or the ratio of output torque value and the torque command value of the 1st dynamo-electric machine, and the charge-and-discharge power of accumulation-of-electricity equipment in the dynamo-electric machine equipment for hybrid cars according to claim 3 or 4 according to the configuration according to claim 5, it is the degree of irreversible demagnetization of a permanent magnet. It can presume with high precision by simple hardware and a simple software configuration. According to the configuration according to claim 6, in the dynamo-electric machine equipment for hybrid cars according to claim 5, it is further based on this judgment result. The sum total of inertia torque and output torque value, or the ratio of output torque value and the torque command value of the 1st dynamo-electric machine, Since relation with the maximum of magnet temperature or the armature current is amended, after irreversible demagnetization generating of a permanent magnet presumes magnet temperature with high precision, or the decision of the permission maximum of the suitable armature current which does not generate irreversible demagnetization further of it is attained. According to the configuration according to claim 7, in the dynamo-electric machine equipment for hybrid cars according to claim 1, a control section presumes the temperature of the armature coil of the 1st dynamo-electric machine further based on the armature current value inputted as permanent magnet temperature. Hereafter, it explains in more detail. Contiguity arrangement of the 1st permanent magnet and armature coil of a dynamo-electric machine is carried out, and if the armature current is 0, it can be considered that it is almost equal. If the armature current flows, the temperature of an armature coil rises by the resistance loss, it will take to it and permanent magnet temperature will also rise. That is, armature coil temperature has a correlation from the present when the temperature gradient between a permanent magnet and an armature coil is brought about, to both the pattern of the armature current within the time amount (effect time amount is called) to predetermined time or before, and permanent magnet temperature. When explaining the pattern of the armature current, the high current flowed in early stages of the above-mentioned effect time amount, in the case of the current 0, the temperature rise of an armature coil was caused by the above-mentioned high current to current after that at heat dissipation of the armature coil after energization, it should be falling, a high current flows conversely at the anaphase of the above-mentioned effect time amount, i.e., just before this time, in the case of a current 0, the temperature rise of an armature coil is caused by the above-mentioned high current before it at heat dissipation of the armature coil after energization, and it does not fall. The heat dissipation engine performance has correlation also in the absolute temperature of an armature coil. Then, the 3 yuan map of the armature current value which took into consideration the heat dissipation engine performance of these armature coils, permanent magnet temperature, and armature coil temperature is measured and memorized beforehand, the permanent magnet temperature and the above-mentioned consideration armature current value which were calculated by the operation can be assigned to this map, armature coil temperature can be presumed, and the safety of a dynamo-electric machine can be improved. In the dynamo-electric machine equipment for hybrid cars according to claim 7, further, based on the temperature of the armature coil of the 1st presumed dynamo-electric machine, the maximum of the armature current in the range which does not produce insulating coat degradation of an armature coil is determined, and, according to the configuration according to claim 8, the armature current is restricted to said under maximum. an armature coil has a resin coat for an insulation, and since it has heat-resistant fixed temperature, this insulating resin coat can do so the effectiveness, i.e., the effectiveness that the dynamo-electric machine of small high power is realizable, that a sink and output increase can be aimed at for the armature current of a until [limit full] dynamo-electric machine, preventing the poor insulation by heating of a dynamo-electric machine, if armature coil temperature can be presumed in this way.

[Embodiment of the Invention] The suitable mode of the relative rotation duplex Rota mold dynamo-electric machine equipment for hybrid cars of this invention is explained with reference to the following examples.

[Example 1] (Configuration) The transmission of the hybrid car which applied the equipment of an example 1 is explained with reference to drawing 1 . a dynamo-electric machine control device with the 1st inverter 31 for the 1st dynamo-electric machine 21 control with which 1 mentions an engine later and a dynamo-electric machine and 3 mention 2 later, and the 2nd inverter 32 for the 2nd dynamo-electric machine 22 control mentioned later, and 4 -- a car control device and 5 -- a brake pedal stepping angle sensor (it is also called a brake sensor) and 9 show a shift lever, and, as for an engine control system and 7, 10 shows a magnet temperature presumption means for accumulation-of-electricity equipment and 6, as for an accelerator pedal stepping angle sensor (it is also called an accelerator sensor) and 8. The car control device 4 has the torque decision means 41 of a hardware configuration or a software configuration, the engine power decision means 42, and the engine revolving-speed-control means 43. The configuration of a dynamo-electric machine 2 is shown in drawing 2 . The 1st rotator of the shape of a drum which 23 was attached in the shaft 20 and fixed, and 24 show the cylinder-like 2nd rotator, 25 shows a cylinder-like stator, the 1st rotator 23 and 2nd rotator 24 constitute the 1st dynamo-electric machine 21, and the 2nd rotator 24 and stator 25 constitute the 2nd dynamo-electric machine 22. 26 shows the rotation sensor of the 1st rotator 23, 27 shows the rotation sensor of the 2nd rotator, and each dynamo-electric machine control unit 3 detects each rotator location using these rotation sensors. The 1st rotator 23 comes to loop around the periphery section of a laminating magnetic core an armature coil, and it separates a small gap to the peripheral face of the 1st rotator 23, and comes to attach it free [the same axle and relative rotation], and the 2nd rotator 24 separates a small gap to the peripheral face of the 2nd rotator 24, and comes to attach it a stator 25 in the same axle. The 2nd rotator 24 is from the laminating magnetic core which has an inner circumference side permanent magnet group for a field pole configuration (not shown), and a periphery side permanent magnet group (not shown), respectively on an inner circumference and periphery side. A stator 25 comes to loop around the inner circumference section of a laminating magnetic core an armature coil, separates a small gap to the peripheral face of the 2nd rotator 24, and is being fixed to housing. Therefore, the inner circumference side permanent magnet set of the 2nd rotator 24 and the 1st rotator 23 constitute the magnet mold synchronous machine of the relative rotation duplex Rota mold which forms the 1st dynamo-electric machine 21, and the periphery side permanent magnet set and stator 25 of the 2nd rotator 24 constitute the magneto system synchronous machine. In addition, these inner circumference side permanent magnet set and the periphery side permanent magnet set are prepared hoop direction regular intervals and alternately with a polarity, respectively.

(Actuation) The fundamental operation control action of the transmission of the hybrid car of this example is explained with reference to drawing 1 and drawing 2 . The torque decision means 41 determines car torque command value Tv' based on the operation information inputted from the accelerator sensor 7, the brake sensor 8, and a shift lever 9. The engine power decision means 42 determines engine power command value Pe' as this car torque command value Tv' and the Pella shaft engine speed Nv which the dynamo-electric machine control unit 3 detected based on the information about loss of a dynamo-electric machine 3, and outputs it to an engine control system 6. An engine control system 6 supplies the fuel corresponding to this engine power command value Pe' to an engine 1 while it determines optimal engine-speed command value Ne' based on engine power command value Pe' and outputs it to the car control device 4. the engine revolving-speed-control means 43 completes it as 0 based on the deflection of engine-speed command value Ne' and the actual engine-speed detection value Ne which the dynamo-electric machine control device detected -- as -- torque command value T1' of the 1st dynamo-electric machine 21 -- determining -- it -- being based -- the 1st inverter 31 -- leading -- the 1st dynamo-electric machine 21 -- being the so-called -- feedback control is carried out. The engine revolving-speed-control means 43 calculates the current command value corresponding to it from torque command value T1', controls an inverter 31, and, specifically, energizes a current equal to this current command value to the armature coil of the 1st rotator 23. Moreover, the engine revolving-speed-control means 43 computes torque command value difference T2'=Tv'-T1' between above-mentioned car torque command value Tv' and torque command value T1' of the 1st dynamo-electric machine, makes this the torque command value of the 2nd dynamo-electric machine 22, and controls the 2nd dynamo-electric machine 22 through the 2nd inverter 32 based on it. The engine revolving-speed-control means 43 calculates the current command value corresponding to it from torque command value T2', controls an inverter 32, and, specifically, energizes a current equal to this current command value to the armature coil of a stator 25. Since the power transfer device control method of this hybrid car itself is a well-known matter, the explanation beyond this is omitted.

(Magnet temperature presumption means 10) The magnet temperature presumption means 10 is explained below. First, the relation between magnet temperature and torque change is explained below. the ratio of the temperature T of the above-mentioned inner circumference side permanent magnet set of the 2nd rotator 24, the absolute value of torque command value T1' of the 1st dynamo-electric machine 21, and the absolute value of the actual output torque T1 -- relation with K is shown in drawing 3 . In addition, if it is the actual output torque T1 at the low-temperature time, it will converge an engine power command value on Pe', and Te=Pe'/(2piNe) and the actual engine torque Te called for by setting an engine-speed detection value to Ne (rps) by above-mentioned feedback control. If a magnet field decreases, even if it passes the armature current equivalent to torque command value T1', it will become small, the absolute value of Te will become larger than the absolute value of T1, and an engine speed Ne will increase the torque T1 actually acquired. That is, if magnet temperature becomes high so that drawing 3 may show, even if it gives the current equivalent to torque command value T1' to the armature coil of the 1st dynamo-electric machine 21, an output torque T1 will decline and torque ratio K will become small. This originates in the phenomenon in which a magnet field becomes small reversibly, if magnet temperature serves as an elevated temperature. A magnet temperature presumption means 10 to presume magnet temperature using the above-mentioned phenomenon can consist of both hardware and software. The example constituted from software is explained below with reference to the flow chart shown in drawing 4 . first -- a car -- a control device -- four -- from -- engine power -- a command -- a value -- Pe -- ' -- an engine speed -- Ne -- the -- one -- a dynamo-electric machine -- torque -- a command -- a value -- T -- one -- ' -- reading (S100) . Next, it asks for the output torque T1 of the 1st dynamo-electric machine 21 equivalent to an engine torque noting that it can consider that it was completed as Te by the output torque T1 by implementation of the above-mentioned feedback control from the formula of Te=Pe'/(2piNe) for which it asked from engine power command value value Pe' and an engine speed Ne. Therefore, as for the operation of this output torque T1, it is desirable to be carried out in a field without sudden change of torque command value T1' of the 1st dynamo-electric machine. (S102) . next, the ratio of the absolute value of torque command value T1' of the 1st dynamo-electric machine 21, and an output torque T1 -- the ratio which computed and (S104) computed K (=|T1|/|T1'|) -- K is substituted for the map of the built-in which memorizes the property of drawing 3 R> 3 beforehand, and the magnet temperature T is searched for (S106). Namely, torque command value T1' of the 1st dynamo-electric machine 31 determined so that this example may make in agreement engine-speed command value Ne' and the actual engine-speed detection value Ne In the hybrid car are made paying attention to the phenomenon of becoming larger than the time of the low temperature by field bundle reduction by the temperature rise of an inner circumference side permanent magnet set, and using a duplex Rota motor Without adding a sensor etc. in any way, also in the dynamo-electric machine which frequent rotational frequency fluctuation produces like a hybrid car, magnet temperature can be easily presumed on real time, using the control parameter used for hybrid car control, and it has the advantage of excelling in practicality.

[Example 2] The transmission of the hybrid car which applied the equipment of an example 2 is explained with reference to drawing 5 . This transmission adds the inertia torque presumption means 100 to the equipment of the example 1 shown in drawing 1 , and it differs in that the configuration of the magnet temperature presumption means 10 was changed. Of course, it does not matter to constitute this inertia torque presumption means 100 from which of hardware and software. This example explains below with reference to the flow chart which shows the example realized by software to drawing 6 .

(Inertia torque calculation by the inertia torque presumption means 100) First, from the car control device 4, an engine speed Ne is received with a suitable time interval, renewal of storage is carried out (S110), and it calculates from this time value Ne of the engine speed Ne which received immediately before (n), and the last value Ne (n-1) of the last engine speed Ne to memorize (S112)., both difference, i.e., acceleration deltaN Next, based on the inertial mass and this acceleration deltaN of the rotation system containing the engine 1 and the 1st rotator 21 which have been memorized beforehand, the inertia torque Ti of this rotation system is searched for (S114), and this inertia torque Ti is transmitted to the temperature presumption means 10 (S116). In addition, the inertia torque Ti is computed from a formula next. M is a proportionality constant and Je is the moment of inertia of the above-mentioned rotation system.

Ti=M-delta N/Je -- the magnet temperature presumption actuation by the magnet temperature presumption means 10 of this example is explained below with reference to drawing 7 .

(Magnet temperature presumption by the magnet temperature presumption means 10) S100 which shows the magnet temperature presumption means 10 to drawing 4 -- the inertia torque Ti -- reading -- S104 of drawing 7 -- the formula of K=|T1+Ti|/|T1'| -- being based -- a ratio -- K is computed and magnet temperature is searched from a map in S106 of drawing 4 . If it does in this way, since the error by the inertial mass can be compensated also in rate change of the rotation system containing an engine 1 and the 1st rotator 23, in the hybrid car accompanied by a frequent rate change, exact magnet temperature is detectable on real time.

(Modification) The inertia torque calculation actuation at the time of carrying out elastic association of an engine 1 and the 1st rotator 23 is shown in the control-block Fig. shown in drawing 8 . For J1, as for the rotational frequency of the 1st rotator 23, and N1 (n), the moment of inertia of the 1st rotator 23 and N1 are

[a value and N1 (n-1)] values last time [the] this time [the]. The inertia torque Ti 23 of only the 1st rotator 23 is searched for by the same approach as drawing 6 , and a changed part Tie of the inertia torque of the 1st rotator 23 under the effect of [from an engine 1] the rotator 23 on the 1st is added at it at the 1st rotator 23, and it considers as the inertia torque Ti of this elastic rotation system.

[Example 3] The transmission of the hybrid car which applied the equipment of an example 3 is explained with reference to drawing 9 . This transmission adds the temperature function amendment means 200 to the equipment of the example 1 shown in drawing 5 , and it differs in that the configuration of the magnet temperature presumption means 10 was changed. Of course, it does not matter to constitute this temperature function amendment means 200 from which of hardware and software. This example explains below with reference to the flow chart which shows the example realized by software to drawing 10 .

(The description of the temperature function amendment means 200) The semantics of a temperature function amendment means 200 to make the description of this example is explained below first. It is called for assuming the relation with Ratio K (=|T1|/|T1'|) that the field of the above-mentioned inner circumference side permanent magnet set is convention reinforcement as the magnet temperature of drawing 3 used in the example 1 at the time of low temperature (in other words there is no irreversible demagnetization of this inner circumference side permanent magnet set). However, when a high current is energized to an armature coil in fact at the time of an elevated temperature, irreversible demagnetization of an inner circumference side permanent magnet set may arise. when this irreversible demagnetization arises, even if magnet temperature is low temperature -- the case where magnet temperature is high -- the same -- the field of a permanent magnet -- decreasing -- the reversible magnet field reduction at the time of an elevated temperature as stated above (reversible demagnetization) -- the same -- a ratio -- K (=|T1|/|T1'|) should decrease -- it comes out. therefore, the ratio by irreversible demagnetization of a permanent magnet when irreversible demagnetization arises -- an error will produce only decrement delta[of K (=|T1|/|T1'|)] K in magnet temperature presumption based on drawing 3 . this specification -- a ratio -- the torque percentage reduction K (=|T1|/|T1'|) is the torque percentage reduction by synthetic demagnetization, and according decrement deltaK to irreversible demagnetization, then torque percentage reduction K' by reversible demagnetization -- K' -- suppose that it becomes equal to -deltak. conversely, the ratio by demagnetization with a permanent magnet irreversible, for example if it says, if decrement delta[of K (=|T1|/|T1'|)] K is known the ratio computed in the example 1, if K (=|T1|/|T1'|) is broken by this decrement deltaK It can ask for torque percentage reduction K' by reversible demagnetization, and it should consider that torque percentage reduction K' by this reversible demagnetization is Ratio K (=|T1|/|T1'|), and should substitute for the property of drawing 3 , and magnet temperature should be able to be presumed correctly. this example -- the above-mentioned recognition -- being based -- the ratio of irreversible demagnetization of a permanent magnet -- the effect on K is compensated and exact magnet temperature is presumed. In the operation control to which the hybrid car mentioned this invention persons above, it noted that the magnitude of demagnetization of an inner circumference side permanent magnet set had the transfer power Pb and the correlation of accumulation-of-electricity equipment. Furthermore, the car transit power Pv which will be determined from car torque command value Tv' and the Pella shaft rotational frequency Nv as mentioned already in the operation control of a hybrid car if it explains, Need [of being the sum total with the loss (power for holding auxiliary machinery power and accumulation-of-electricity equipment on proper charge level) Px of a dynamo-electric machine 3] power sigmaP is made equal to engine power command value Pe', and it sets up so that accumulation-of-electricity equipment may be held without charge and discharge on this proper charge level by this stable state. However, in spite of carrying out feedback control of torque command value T1' of the 1st dynamo-electric machine 31 so that the deflection of engine-speed command value Ne' and the actual engine-speed detection value Ne may be completed as 0 if demagnetization of the permanent magnet of an inner circumference side permanent magnet set arises 'The torque command value difference T2 between car torque command value Tv' called for from the formula of -T1' and torque command value T1' of the 1st dynamo-electric machine' becomes small. the absolute value of T1 -- the absolute value of T1' -- small -- becoming -- T2'=Tv -- A difference will arise between engine power and the load for a car drive, and only the part will increase [the charge-and-discharge power Pb of accumulation-of-electricity equipment]. Therefore, extent of irreversible demagnetization of an inner circumference side permanent magnet set can be presumed from the charge-and-discharge power Pb of the accumulation-of-electricity equipment in the predetermined temperature requirement which elevated-temperature demagnetization does not produce.

(Actuation of the temperature function amendment means 200) With reference to the flow chart which shows the example which realized the temperature function amendment means 200 by software to drawing

10 , it explains below. When there is no demagnetization, most dispersion (here standard deviation) of the average Pbm of the data of the predetermined number which sampled and acquired the charge-and-discharge power value of accumulation-of-electricity equipment at constant spacing during a fixed period is 0, and if demagnetization arises, the standard deviation of Pbm will become large for an above-mentioned reason. So, in this example, the magnitude of irreversible demagnetization (namely, torque percentage reduction deltak by it) is judged in the magnitude of the standard deviation of Pbm at the time of the low temperature which elevated-temperature demagnetization does not produce. Specifically it is in the condition that the permanent magnets after predetermined time etc. still are not elevated temperatures, the standard deviation of the average charge-and-discharge power value Pbm is first, calculated in the state of predetermined steady operation preferably for example, from engine starting, (S120), and it inserts in the map of drawing 13 which memorizes it beforehand, and asks for deltaK (=|T1|/|T1'|) corresponding to the standard deviation of this average charge-and-discharge power value Pbm (S122). next, the ratio by which this deltaK was outputted to the magnet temperature presumption means 10 (S124), and self searched for the magnet temperature presumption means 10 immediately after S104 -- K (=|T1|/|T1'|) is broken by this reduction ratio K', and it asks for torque percentage reduction K' by reversible demagnetization, it considers that this K' is K of drawing 3 , and magnet temperature is presumed in S106. In addition, since the standard deviation of the average Pbm of the charge-and-discharge power of the accumulation-of-electricity equipment shown in the map of drawing 13 and the relation with the above-mentioned ratio K are changed by change of other parameters, such as temperature and a current, two or more maps are prepared for every various values of other parameters, and they can also choose the optimal map according to the value of the other detected parameters.

[Example 4] The transmission of the hybrid car which applied the equipment of an example 4 is explained with reference to the flow chart of drawing 12 . this example -- S106 of drawing 4 -- a ratio -- the ratio which does not search for the magnet temperature T but is beforehand memorized from a map based on K (=|T1|/|T1'|) -- the map in which the relation between K (=|T1|/|T1'|) and the maximum-permissible armature current of the armature coil of the 1st rotator 23 is shown -- a ratio -- K is introduced and it is characterized [that] by the point of searching for the maximum-permissible armature current. In addition, the maximum-permissible armature current here means the maximum of an armature current current which can consider that irreversible demagnetization of the inner circumference side permanent magnet set of the 2nd rotator 24 is 0. If it does in this way, the output of the 1st dynamo-electric machine 21 can be raised to the limitation restricted with the magnet temperature at that time.

[Example 5] The transmission of the hybrid car which applied the equipment of an example 5 is explained with reference to the flow chart shown in drawing 13 . This example presumes the armature coil temperature Tc based on the permanent magnet temperature T presumed in each above-mentioned example, and the average Im of the armature current in the period from this time to before predetermined time, presumes the armature current value Imax of the range where an insulating coat does not exceed a permissible maximum temperature from this armature coil temperature Tc further which can be maximum energized, and obtains the dynamo-electric machine of small high power by restricting the armature current to under this Imax. First, the permanent magnet temperature T presumed in each above-mentioned example is read (S142), the average Im of the armature current in the period from this time to before predetermined time is calculated (S144), Above T and Im is substituted for the permanent magnet temperature T memorized beforehand, the average Im of the armature current, and a map with the armature coil temperature Tc, and the armature coil temperature Tc is searched (S146). Next, the above-mentioned armature coil temperature Tc is substituted for the map in which this armature coil temperature Tc memorized beforehand and relation with the armature current value Imax which can be maximum energized are shown, the armature current value Imax which can be maximum energized is searched (S148), and that of the armature current is restricted to under this Imax of this (S150). If it does in this way, irreversible demagnetization of a permanent magnet can be prevented upwards and insulating coat degradation of an armature coil can also be prevented. In addition, if the map of S146 and the map of S148 are unified, the map in which the relation between the permanent magnet temperature T, the average Im of the armature current, and the armature current value Imax that can be maximum energized is shown is prepared and the average of the average Im of the permanent magnet temperature T and the armature current is substituted for it, the armature current value Imax which can be maximum energized can be calculated by easier processing.

(Modification) Although the average of the armature current of the last predetermined period was adopted as an armature current value assigned to a map It may be used in quest of the weighted average efficiency of the armature current which applied the weighting factor which becomes so small that time amount goes back to the armature current value data of the predetermined number which carried out the constant spacing sampling, and which was obtained at the last predetermined period, and took heat dissipation into consideration. or -- the constant value which includes the armature current for 0 in order to make count simple -- regarding -- the duality of permanent magnet temperature and armature coil temperature -- armature coil temperature may be specified on a map.

[Translation done.]

* NOTICES *

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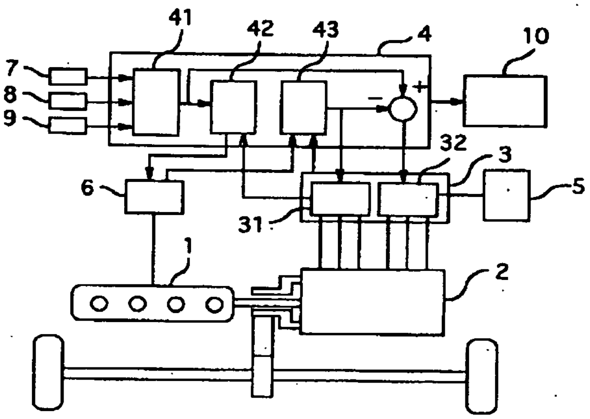
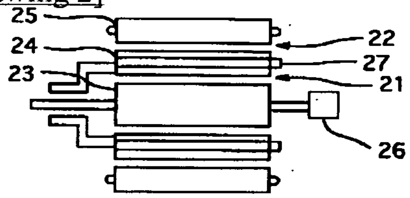
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

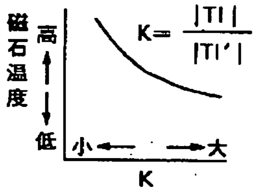
[Drawing 1]



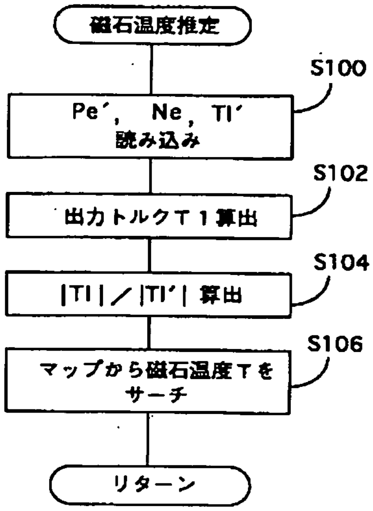
[Drawing 2]



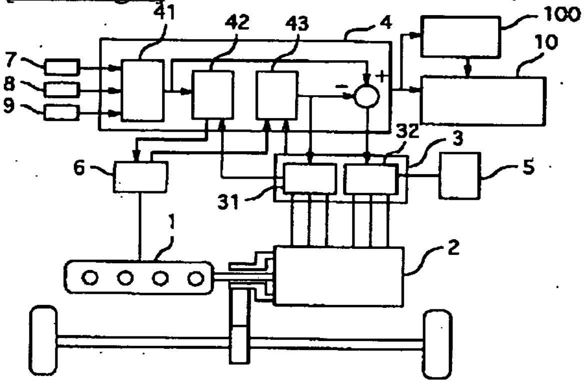
[Drawing 3]



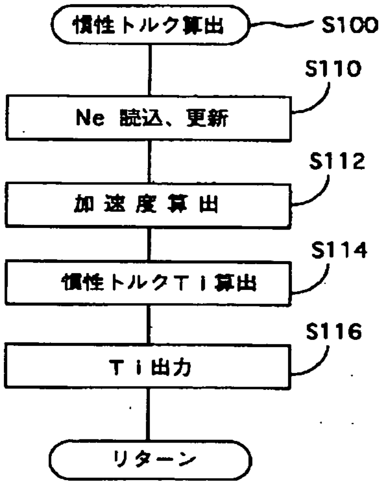
[Drawing 4]


磁石温度推定
S100
Pe′, Ne, Tl′
読み込み
S102
出力トルクT1算出
S104
|Tl|／|Tl′| 算出
S106
マップから磁石温度Tを
サーチ
リターン

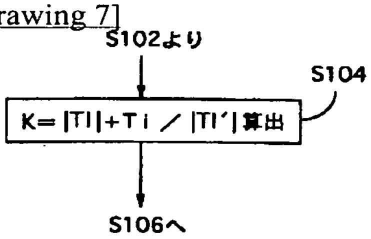
[Drawing 5]


41
42
43
4
100
10
7
8
9
−
+
32
3
6
5
31
1
2

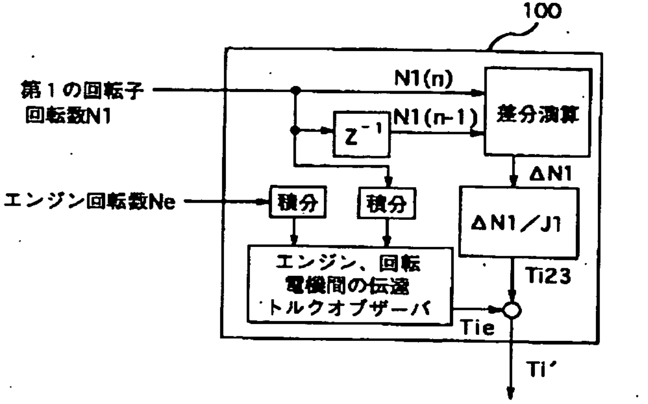
[Drawing 6]


慣性トルク算出
S100
S110
Ne 読込、更新
S112
加速度算出
S114
慣性トルクTi算出
S116
Ti出力
リターン

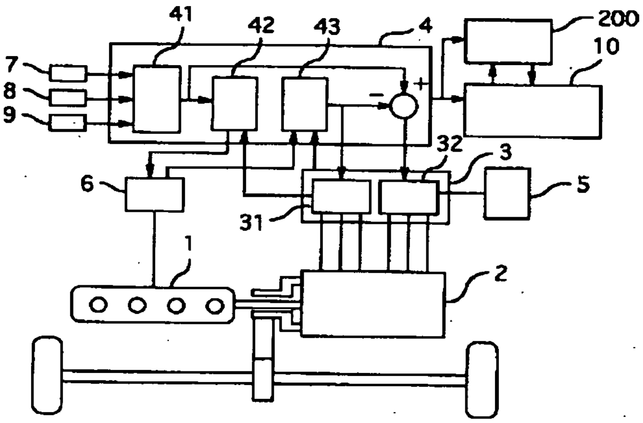
[Drawing 7]


S102より
S104
K=|Tl|+Ti／|Tl′|算出
S106へ

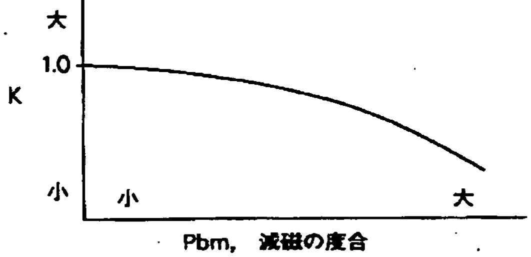
[Drawing 8]


100
第１の回転子
回転数N1
エンジン回転数Ne
N1(n)
N1(n-1)
Z⁻¹
差分演算
ΔN1
積分
積分
ΔN1／J1
エンジン、回転
電機間の伝達
トルクオブザーバ
Ti23
Tie
Ti′

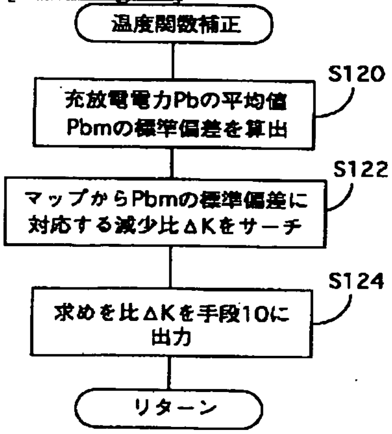
[Drawing 9]


41
42
43
4
200
10
7
8
9
−
+
32
3
6
5
31
1
2

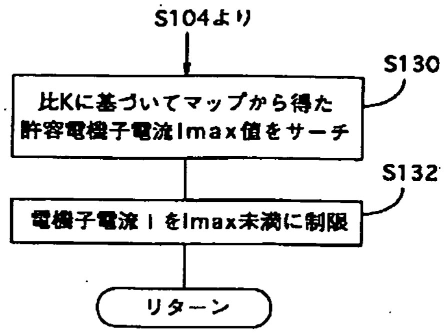
[Drawing 11]



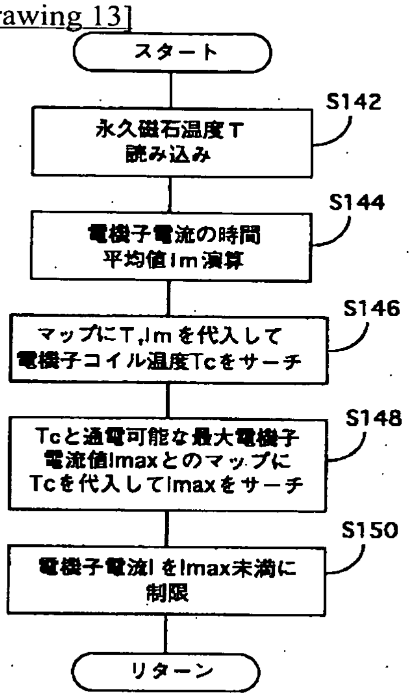
[Drawing 10]


温度関数補正
充放電電力Pbの平均値
Pbmの標準偏差を算出
S120
マップからPbmの標準偏差に
対応する減少比ΔKをサーチ
S122
求めを比ΔKを手段10に
出力
S124
リターン

[Drawing 12]


S104より
S130
比Kに基づいてマップから得た許容電機子電流Imax値をサーチ
S132
電機子電流 I をImax未満に制限
リターン

[Drawing 13]


スタート
S142
永久磁石温度T読み込み
S144
電機子電流の時間平均値Im演算
S146
マップにT,Imを代入して電機子コイル温度Tcをサーチ
S148
Tcと通電可能な最大電機子電流値Imaxとのマップに Tcを代入してImaxをサーチ
S150
電機子電流I をImax未満に制限
リターン

[Translation done.]